FIFTY CONCLUSIONS

RELATING TO THE ERUPTIVE PHENOMENA OF
MONTE SOMMA, VESUVIUS
AND VOLCANIC ACTION IN GENERAL.

by

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also a

LIST

of

Books, memoirs, principal letters and other signed pubblications of the author

FROM 1876 TO 1890

NAPLES
PRINTED BY FERRANTE, VICO TIRATOIO 25
May, 1890

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H. J. JOHNSTON-LAVIS Esqr. M. D., M. R. C. S., B. ès Sc., F. G. S., etc.

PREFATORY NOTE

In the years from 1879 to 1883 much attention was devoted by me to the elucidation of the geological history and physical phenomena as illustrated by the products of the great Neapolitan volcano. In the spring of 1883 the results of my investigations were embodied in a long memoir which was forwarded to the Geological Society of London, where it was read on June 20th 1883. (Abstracts of the Proceedings of the Geol. Soc. London. Session 1882-83) p. 106 and in part published in February 1884. Unfortunately much of Part I. referring to the origin of the mountain was excised as well as 50 conclusions, at the end of my memoir, to which I had been led by my researches. This has exposed me to two inconveniences. In the first place I have been violently attacked regarding my explanation of the form of the Somma-Vesuvius massif which could hardly have occurred, or at least that part which refers to the question of when and how the Atrio crater was excavated , had the entire memoir appeared. In the next place other writers at much later dates have brougt forward deductions similar to my own. To prevent further trouble I have now published the conclusions which I hope will serve as a guide to vulcanologists in other regions.

Many of those conclusions have been extended and published in another paper (The Relationship of the Structure of Rocks to the Conditions of their Formation.) Scientif. Proceed. R. Dublin Soc. Vol.V., N.S., July 1886, pp. 113 to 156) which was first offered to the Geol. Soc. of London, read, but refused publication (The Physycal Conditions Involved in the Injection, Extrusion and Cooling

of Igneous Matter. (Abstracts of the Proceedings of the Geol. Soc. Lond. Session 1884-5. p. 78). As unfortunately many investigators who occupy themselves with this question are unacquainted with that paper, the conclusions that led up to its elaboration can now be in their hands.

CONCLUSIONS AND DEDUCTIONS

1. Monte Somma is comparatively late as a volcanic focus in the « Campi Phlegræi », to which it belongs.
2. This is proved by the absence of leucitic rocks in the volcanic tufa upon which it rests.
3. There is no distinct evidence to prove that these latter igneous products issued by the same vent that gave birth to Mt. Somma. They were probably the result of submarine or sub-aerial eruptions in the same volcanic area.
4. That the volcanic tufas earlier than Somma repose on late tertiary marls etc., of non volcanic origin, these again on the eocene "*Macigno*" which in turn mantles the cretaceous appenine limestone.
5. Judging from what we know of the first appearance of all new volcanoes, like them, this one commenced by an explosive eruption.
6. That this first eruption gave rise to pumiceous ejectamenta similar to products that were formed in its later intermittent stages.
7. This eruption has passed by gradation into a state of chronic activity such as we see portrayed in the leucitic lavas in the escarpment of the Atrio.
8. This chronic activity was the great agent in building up the main bulk of the mountain, and the phenomena were very similar if not identical with those from A. D. 1631 to the present day going on from the Vesuvian cone.
9. From arrest of supply of magma or exhaustion of heat in the volcanic canal, the igneous forces failed for the time being to make themselves shown at the surface, but were probably storing up energy for a future outburst so producing an apparent extinction of the volcano.
10. This apparent extinction was broken from time to time by explosive eruptions.
11. These eruptions were due to the contact of superheated igneous matter with water-bearing rocks, during which they ab-

sorbed a certain amount of aqueous matter proportioned to the temperature, pressure and length of contact. In this manner the eruption would take place when the elastic tension of the volatile constituent of the magma overcame the superincumbent pressure.

12. This eruption might be hastened or determined by increased pressure coming from below at the igneous reservoir or source of igneous matter.

13. The products of such an eruption must have a tendency to be fragmentary and vesicular in proportion to the temperature and amount of igneous matter in the magma.

14. That vesicular structure is due to the molecular conversion of the dissolved or combined aqueous matter into vapour. This change resulting in the absorbtion of much heat, so as to cause the rock mass to solidify before the vesicles could escape.

15. In rocks that have reached the surface, crystalline structure or the proportion of « formed matter » that separates after extrusion depends also upon the rapidity of cooling which is seen to be chiefly due to the amount of included volatile matter.

16. That when this volatile matter is small in quantity, instead of the igneous magma being torn assunder by its own inherent expansion, il will issue as a continuous stream forming a lava flow , which will possess a high temperature relatively to what it originally had, less what would be lost by the expansion and escape of aqueous vapour.

17. Cooling will be proportional to the last cause and to the rapidity and viscisitudes of outflow.

18. That as extratelluric crystallisation of a pumice is in a ratio to its rapidity of cooling, so also is that of lava.

19. This explains the fact observed at Vesuvius and elsewhere that lava of fine grain contained much water and vice versa.

20. The most favourable circumstance to complete large constituent extratelluric-formed crystals are 1st primitive high temperature of the igneous matter, 2nd the small loss of heat from the paucity and therefore volatilization and escape of vapour, 3rd the length of time the fluid magma is retained simmering under low pressure in the chimney of a volcano.

21. That this also explains why the very small streams that gutter over the edge of the vesuvian crater are rich in large leucites and pyroxenes as all those produced by the almost continuous

outpour of lava during the last ten years, but are absent from long streams such as the fine examples of 1872 and 1631.

22. That there is a distinction between pumice and scoria.

23. This difference depends upon the origin and character of their respective vesicular structure. In the case of pumice, the cavities result from the interstitial molecular separation and union of a gaseous or volatile matter, which in part escapes breaking up and carrying with it the fragments of the igneous rock which from their consequent rapid cooling prevent the escape of the residual vapour bubbles resulting in the spongy structure. In scoria the vesicularity is due to the formation of a froth, the cavities being formed not solely from the local inherent volatile matter alone, but from that derived from all the thickness of a mass of lava, which floats to the top to form a scum.

As the vapour will only rise through the pasty mass when the bubbles are of considerable size, the cavities in scoria are proportionally large in comparison to those in pumice.

As the mass-weight of a vesicular rock is dependent upon the cubic area of the vesicles, other things being alike this accounts for a pumice weighing less, bulk for bulk, than the scoria.

The higher Sp. G. of the crystalline components of the scoria also and the abundant vitreous matter composing the base of the pumice will make a still greater difference between them.

24. That not only does igneous matter modify the rock walls in which it is contained, but that they also may modify its composition by an interchange of chemical constituents.

25. That in an eruption the ejectamenta is made up of three elements.

Primary or essential. The true igneous matter in the form of lava, pumice, scoria, ash etc. — *Secondary or accessory:* Materials derived from the crater walls of the cone i. e. cooled rocks and other products of earlier eruptions derived from the same volcano. — *Tertiary or accidental:* Rocks which compose the basis of a volcano; and which may be igneous, or sedimentary rocks derived from other sources. (1)

( ) Perhaps the second of each of these terms is more suitable, so avoiding any confusion of the great divisions of sedimentary rocks.

26. A very high temperature and much aqueous matter produces a vitreous pumice.

27. A very high temperature and less aqueous matter produces a microlitic pumice.

28. A high temperature and little aqueous matter produces a pumiceous scoria rich in large crystals, but with a vitreous base (within certain limits).

29. The two latter conditions but especially the last seems most favourable to the crystallization of Leucite.

30. That it may be stated generally that Amphibole and Sanidine and other felspars are commonest as minerals formed previous to escape of explosive ejectamenta, (intratelluric) whereas Augite and Leucite belong to the ejection and subsequent period and are commononest in non explosive lavas etc.

31. That the pumice was not derived from the tearing up of earlier trachytic rocks beneath M^te^ Somma (Scrope) but were in each, independant productions from the heated matter producing the eruption. If they were not so, we should expect each deposit to be a mixture of different kinds of pumice , whereas by a single hand specimen the eruption can be determined by which it was ejected.

32. M^te^ Somma was originally a pretty regular cone about 7000 feet or 2300 meters high.

33. Each explosive eruption hollowed out or enlarged the size of the crater up to a certain limit.

34. Either the first or some later explosive eruption did not occur from the original axis of the mountain, but from a point slightly to the west of south of it.

35. The later of these eruptions enlarged the crater to such an extent as to carry its apex below drainage level, thus modifying the eruptive phenomena.

36. This crater extended below the base of the mountain through the tertiary rocks into the Appenine limestone.

37. These rocks especially the latter were highly metamorphosed by previous contact with igneous matter, thus accounting for the great variety of ejected blocks.

38. That barancos produced by either one or two methods or both combined, opened into the crateral hollow and drained it.

39. The result of such drainage was the local deposit of a breccia Phase III, period 4, on the slopes or foot of the mountain

near that locality now seen in the Vallone Grande and its neighbour Vallone di Pollena.

40. That Lyell's statement that there were valleys of denudation between one tufa and another is perfectly correct.

41. These valleys do not necessarily correspond to the recent ones, but that probably little alteration has occurred in the basin drained by each.

42. The eruption that commenced as a violent explosive one producing a very vitreous pumice by a series of probably intermittent stages, terminated by the outflow of true lavas.

43. The products of the first outburst of an explosive eruption are much more vitreous and poorer in formed matter than that ejected later, in which the expansive force has deminished. This is the result of the longer time allowed for cooling by that portion which is deepest in the volcanic chimney and which also from being enclosed in dryer rocks had probably absorbed less water.

44. The present chronic activity was the gradual result of a series of eruptions begining as an explosive one similar to that of the year A. D. 79.

45. The vesuvian cone is not concentric with the old Mte Somma, but it is roughly with that of the axis of the eruptions that formed the great crater of the Atrio del Cavallo.

46. The valleys present different and special characters in different parts of their course which depend upon the change in the angle of inclination, and upon the kind of rocks traversed.

47. That the phenomena of the prehistoric volcano were similar in all respects to what we know as occuring in historic times.

48. Volcanic action depends first upon variations of tension in the primary igneous mass, and this is modified in violence and the character of its products, by the different conditions to which the escaping portion is subjected in reaching the surface and its deposition there.

49. In all probability the volcanic products of the neigbourhood are all derived from the same reservoir as that of Vesuvius, but difference in composition and structure is due to the various influences brought to bear on the original primitive matter in its journey from its source, to its deposition upon the surface.

50. That nearly all the superficial manifestations of volcanic action can be explained without exception by this theory originating in the study of, and illustrated by, Monte Somma and Vesuvius.

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2 1877. — Notes on the Geology of Lewisham; — *Proceed. Geol. Assoc. Lond. Vol. IV, pp. 528 to 543, with 5 woodcuts.*

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4 1879. — A short History of the Town of Stalbridge, Staplebridge, Stawbridge, or Stapleford, Dorsetshire. — *Stalbridge Almanach (Meader's) for 1879, pp, 1 to 3.*

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8 1880. — Iron and Hydrogen. — "*Nature,*" *Vol XXII. p. 220.*

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18 1883. — Il parere d'uno scienziato. — "*Il Piccolo*" *(Naples) Sept.* 2nd *1883.*

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20 1883. — The Disaster in Ischia. — "*Indianapolis Journal.*" *Sept.* 6th *1883.*

21 1883. — Una risposta al Prof. Palmieri.—"*Il Piccolo*" (*Naples*) *Sept.* 8th *1883.*

22 1883. — Etude sur l'emplacement des nouvelles villes a l'ile d'Ischia. "*L' Italie*" *(Rome) Sept.* 15th *1883.*

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28 1884. — The Late Eruption of Vesuvius. — *Ibid., p. 291.*

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35 1885. — Monograph of the Earthquakes of Ischia, a Memoir Dealing with the Seismic Disturbances in that Island from Remotest Times with Special Observations on those of 1881 and 1883—*Dutau, London and Furchheim, Naples, 1885 in royal 4°, pp. X and 112, with 20 photo-engravings, 2 large maps in color, 3 lithographic plates and 1 chromo-lithographic plate.*

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38 1885. — On the Preparation of Sections of Pumice-stone and other Vesicular Rocks.—*Journ. R. Microscop. Soc., Ser. II. Vol. VI, pag. 32-34.*

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43 1886. — Vesuvian Eruption of February 4th 1886, — *Ibid. p. 367.*

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47 1886. — Second Report of the Committee for the Investigation of the Volcanic Phenomena of Vesuvius and its Neighbourhood. — *Brit. Assoc. Reports, pp. 3, also "Nature" Vol. XXXIV, p. 481.*

48 1887. — L'Eruzione del Vesuvio nel 2 Maggio 1885. — *Ann. d. Accad. O. Costa d. Aspiranti Naturalisti. Era 3. Vol. I. Naples, pp. 8 with 1 photo-engraving and 1 cromo-lithograph.*

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75 1890. — The State of the Active Sicilian Volcanoes in September 1889.—*Scottish Geograph. Mag.. Vol. VI. N.° 3, March 1890, pp. 145-150.*

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77 1890. — Osservazioni geologiche sulle isole Ventotene e Santo Stefano (Gruppo delle Isole Ponza). *Ibid. pp. 60-64.*

78 1890. — Nuove osservazioni geologiche in Napoli e suoi dintorni—*Ibid. pp. 65-68.* (A curious error has been made by the translator who seems to have been affected by a mental Daltonism. (*On page 67, line 3, 6 and 9 for "verdi" "read rossi" i.e. for "green" read "red.")*

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